From Academia to Industry

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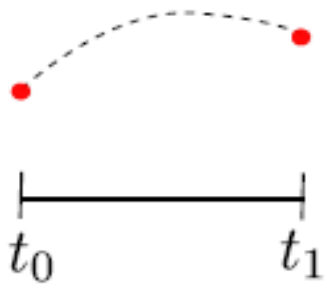
Construction of Adaptive Multistep Methods for Problems with Discontinuities, Invariants, and Constraints

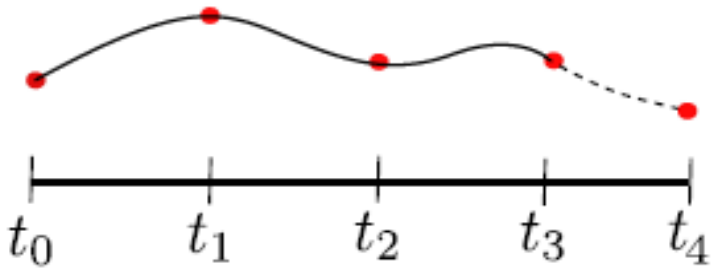
The model overview

Consider an initial value problem of the form,

$$\dot{x} = F(t, x), \qquad x(t_0) = x_0, \qquad t \in [t_0, t_f]$$



One-step method



Multistep method

Linear multistep methods

$$x_n = \sum_{i=1}^{k} \alpha_{k-i} x_{n-i} + h \sum_{i=0}^{k} \beta_{k-i} F(t_{n-i}, x_{n-i})$$

- Start\Re-start of multistep methods
- Multistep methods for semi-discretized hyperbolic PDEs
- Adaptive multistep methods for DAEs

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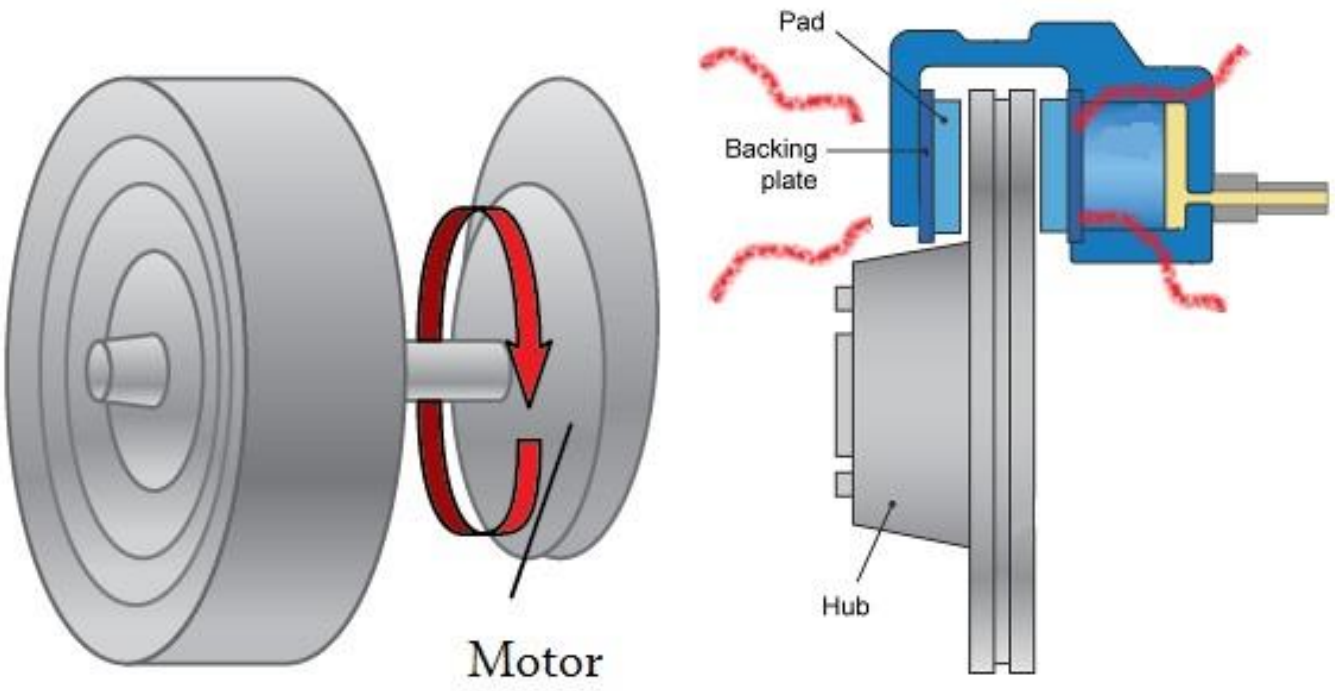
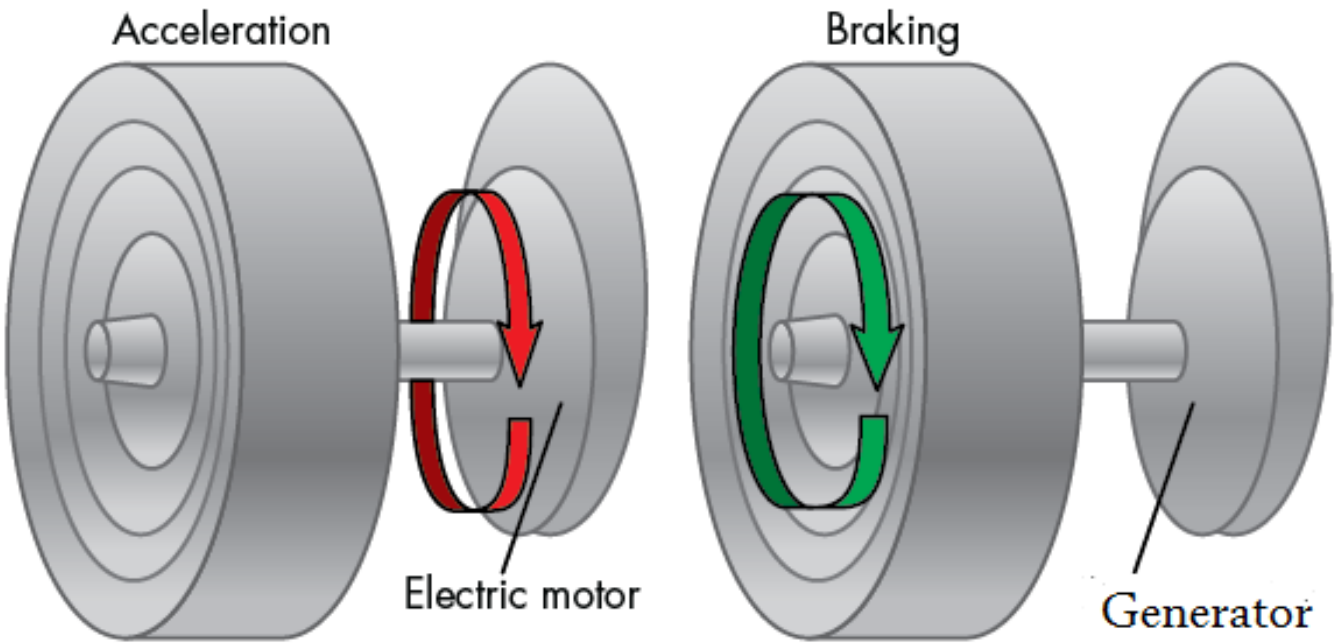
Friction brake system



Brake uses friction to convert kinetic energy into heat.

Regenerative brake system



The kinetic energy is transformed into electricity.

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Blended braking system

Regenerative brake limitations:

- Power of motor
- Capacity of battery
- Safety

How to overcome these limitations?

Regenerative brake + Friction brake

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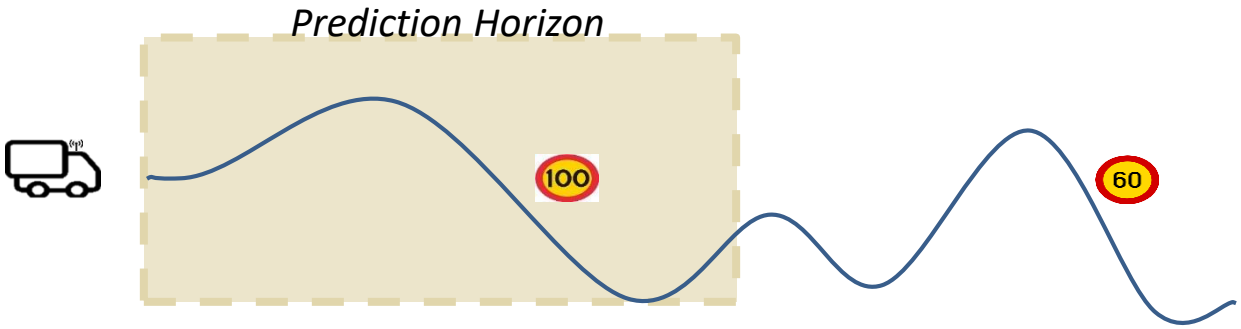
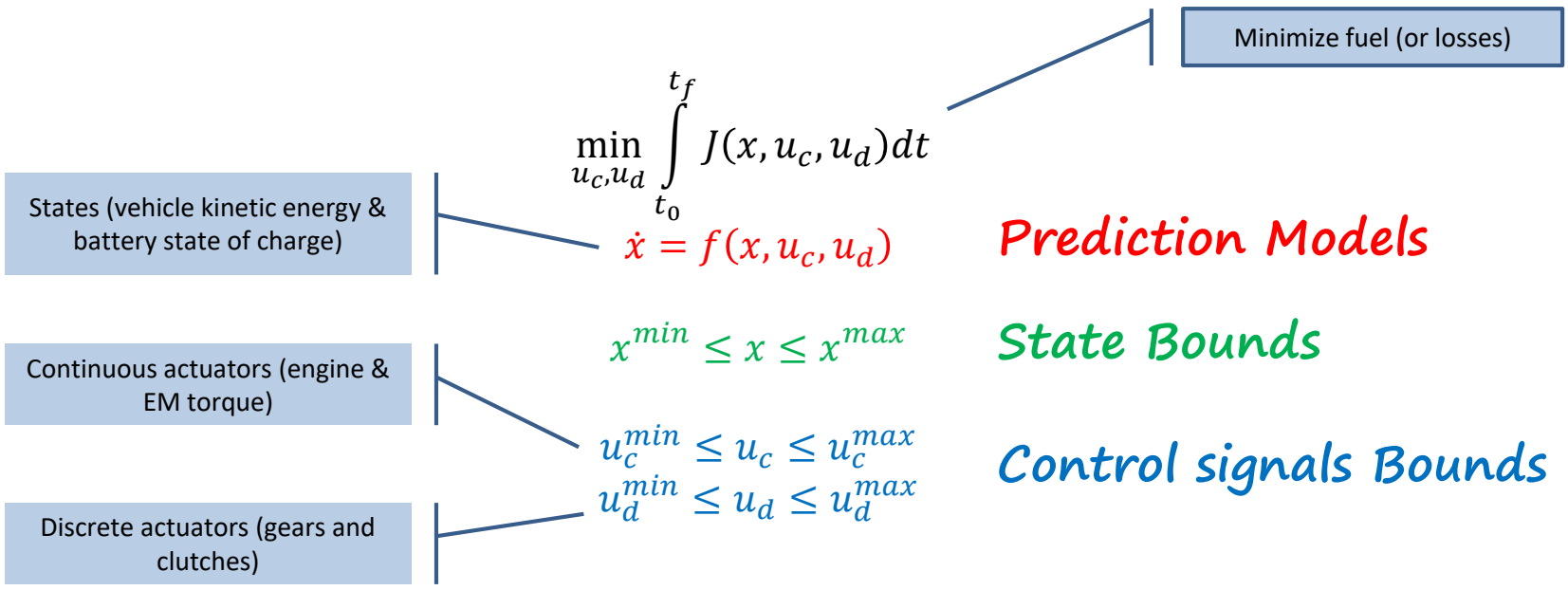
Model prdictive control



Task: Minimize fuel consumption
Constraints: Speed within upper and lower bounds
Output: Speed, gear

Approach:
Model based optimal control using prediction

Optimize the energy over a prediction horizon



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